March 9, 1971 E. L. SWENSEN ET AL 3,568,390

REINFORCED FLOOR PANEL STRUCTURE

Filed Feb. 24, 1969 2 Sheets-Sheet 1

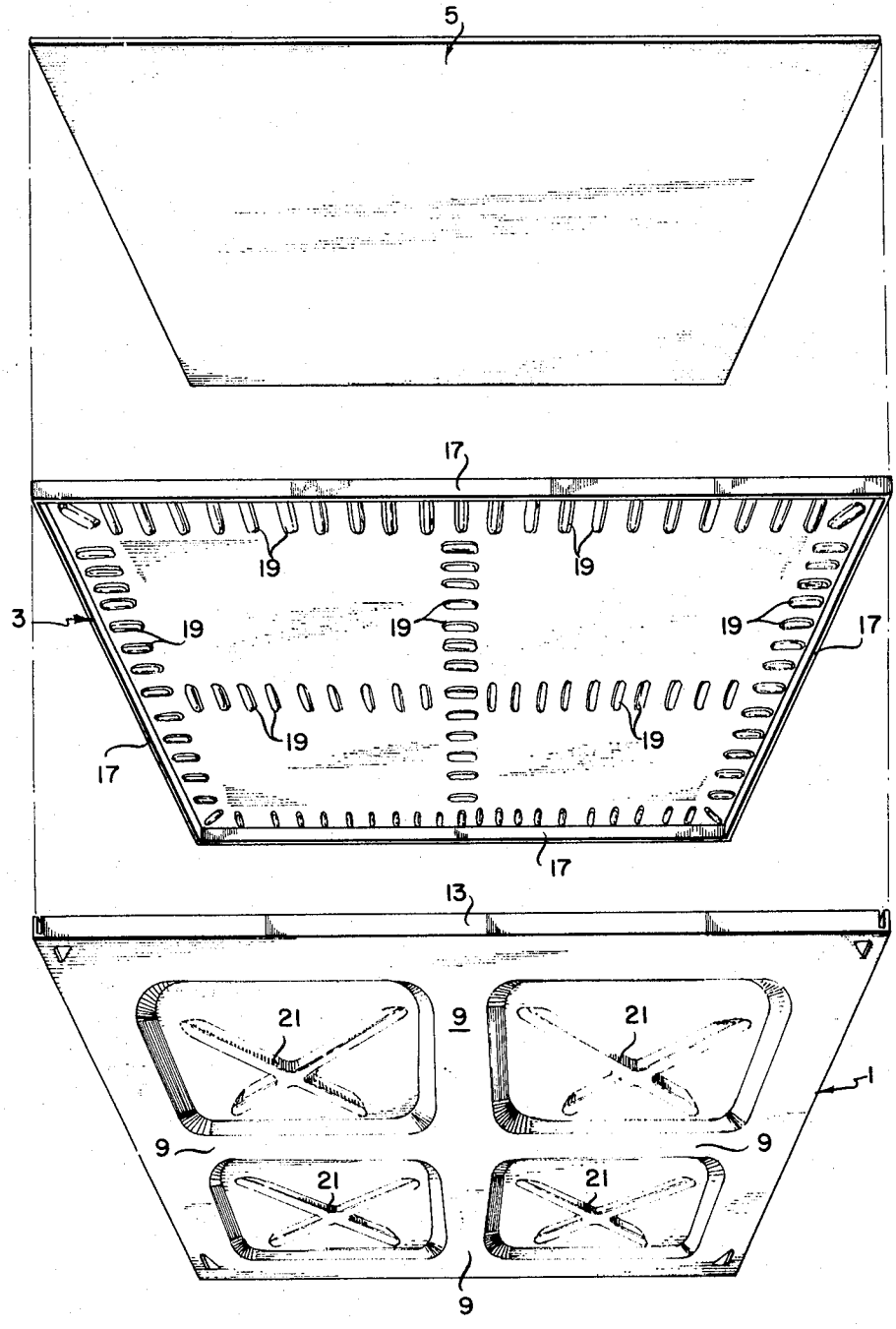


Fig. 1

INVENTOR
Eugene L. Swensen
Raymond Gerald Sartori

BY Mason, Mason & Albright
ATTORNEYS

March 9, 1971 E. L. SWENSEN ET AL 3,568,390

REINFORCED FLOOR PANEL STRUCTURE

Filed Feb. 24, 1969 2 Sheets-Sheet 2

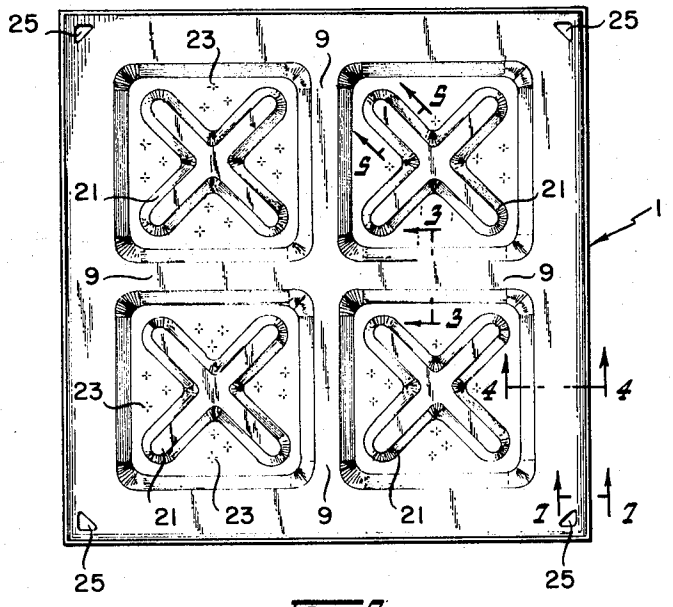


Fig. 2

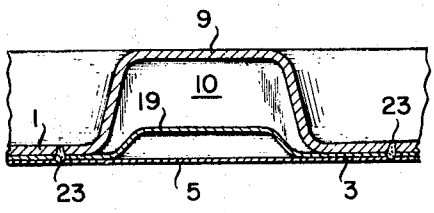


Fig. 3

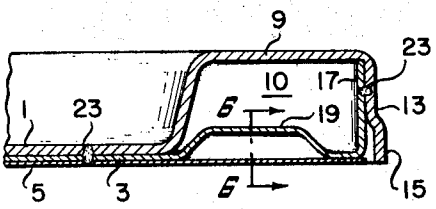


Fig. 4

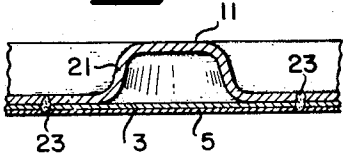


Fig. 5

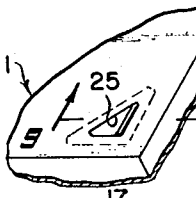


Fig. 8

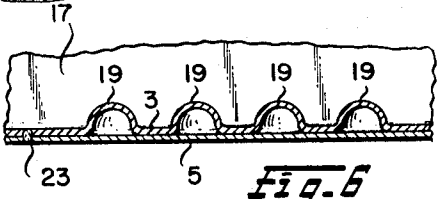


Fig. 6

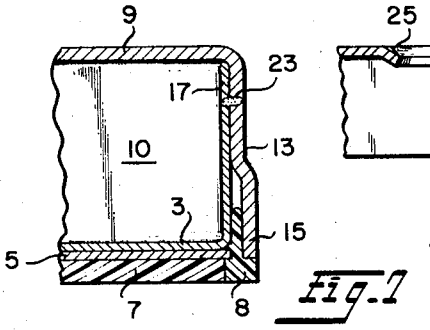


Fig. 7

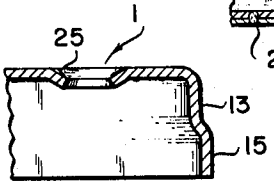


Fig. 9

INVENTOR
Eugene L. Swensen
Raymond Gerald Sartori

BY Mason, Mason & Albright
ATTORNEYS

United States Patent Office 3,568,390 Patented Mar. 9, 1971

3,568,390

REINFORCED FLOOR PANEL STRUCTURE

Eugene L. Swensen and Raymond Gerald Sartori, Rockville, Md., assignors to Liskey Aluminum, Inc., Elkridge Landing Road, near Baltimore Friendship Airport, Md.

Filed Feb. 24, 1969, Ser. No. 801,442
Int. Cl. E04g 15/18
U.S. Cl. 52—619 8 Claims

ABSTRACT OF THE DISCLOSURE

A floor panel to be used in an elevated floor assembly, including a flat top sheet member receptive to a tread surface, a bottom sheet with raised ribs and an intermediate sheet with corrugations. The intermediate and bottom sheet have opposing flanges that overlie one another to form panel sides. The ribs of the bottom sheet form channeled beams along the edges of the panel. The corrugations of the intermediate sheet are located within the channeled beams, the top sheet member and under sheets are secured to one another so that the panel resists deformation and deflections under load.

This invention relates to a floor panel of improved construction that can be quickly assembled to form elevated false floors of the type in which a series of pedestals are used to support corners of the panels, with or without stringer members bridging the pedestals. Elevated false floors are well known for use in the computer room to provide sub floor space for the multitude of wires, cables and accessory equipment for the machinery that rests on the false floors. The panels which make up such floors must be strong enough to support heavy machinery yet readily removable so that access to all parts of the electrical equipment is possible. At the same time the false floor panels define an air plenum with the original floor whereby air at controlled temperatures can be circulated to all parts of the computer equipment.

The panels of the instant invention are designed to be particularly resistant to deformation and deflection under heavy load so that the integrity of the entire floor is preserved even after heavy machinery is installed. Further, the panels disclosed herein can be used with or without stringers bridging the pedestals depending on the intended use of the false floor.

It is an object of this invention to provide a floor panel that has a high strength to weight ratio, even where different materials such as plastic, aluminum or steel, are used to form the panel. It is another object to provide a panel in which "local" deflections are minimized even in relatively unsupported areas. It is a further object to provide a panel that will allow one or more die cut opening without significant strength loss so that electrical cables can be received in the panel once a floor system has been built. It is still another object to provide a panel in which a resilient edge trim is securely held by built in features of the panel thereby permitting the panel to be fitted in place without trim dislodgment.

FIG. 1 is an exploded view of the panel showing the main structural elements that make up the panel.

FIG. 2 is a bottom plan view of the panel showing the unique design of the bottom sheet.

FIG. 3 is a section view taken along the lines 3—3 of FIG. 2.

FIG. 4 is a section view taken along the lines 4—4 of FIG. 2.

FIG. 5 is a section view taken along the lines 5—5 of FIG. 2;

FIG. 6 is a section view taken along the lines 6—6 of FIG. 4;

FIG. 7 is a section view taken along the lines 7—7 of FIG. 2 showing the vinyl edge trim wedged and held flush around the upper periphery of the panel;

FIG. 8 is a fragmentary view of the corner of the bottom sheet showing a corner aperture; and

FIG. 9 is a section view taken along the lines 9—9 of FIG. 8.

In FIG. 1, the understructural elements or shown which include a bottom sheet 1, an intermediate sheet 3, and a top flat sheet member 5. The primary purpose of the sheet member 5 is to provide a flat surface to which a tile 7 (FIG. 7) or other tread surface can be adhered. It is considered important that this sheet 5 remain completely flat, that is, with no turned down flanges or other protuberances, in order that it may provide support to the full extremity of the tile surface. This is in contrast to some panels currently in service which utilize a turned down flange on a top sheet to serve as part of the edge member. Such a structure allows the tile to be unsupported over the radius of the flange.

The intermediate sheet 3 serves a multitude of purposes. However, the primary purpose of sheet 3 is, when attached to the top sheet member 5 by welding or other means, sheet 3 serves to stiffen the top sheet member in all areas which are unsupported by bottom sheet 1. As shown by FIGS. 1 and 6, the intermediate sheet 3 is deformed to have a series of sinusoidal wave forms or undulations 19, the span of which preferably runs perpendicular to the greater span length of the strength ribs 9 of the bottom sheet 1. As such, each wave form contacts and supports the top sheet 5 at its crest and serves as a minor beam to distribute and spread an applied load to its natural reaction points at each end, which very nearly coincides with the vertical webs of the main strength ribs 9 of the third element sheet 1.

It has been found by calculation that the relative stiffness of the two sheet elements 3 and 5 when so formed and attached, can be as much as several magnitudes greater that the stiffness of a single sheet equal to the composite thickness.

The object of the design disclosed herein, is to provide an effective top element composed of the top sheet member 5 and intermediate sheet 3, which when combined, serves to allow lesser deflections or local indentation under load than known steel panel designs now used in elevated floor assemblies.

A second feature of the intermediate sheet 3 is the down turned flanges 17 on each of the four sides of the panel. The purpose of the flanges 17 is to function as spacing means to ensure an accurate separation of the first and third sheet elements 1 and 5, and also to serve as an attachment area to the lower sheet 1, thereby adding greater strength to the panel edge. Flanging of the intermediate sheet 3 accomplishes the above while protecting the flat surface and full tile support requirement of the top sheet member 5 as previously described.

The use of a formed sheet having a series of undulations 19, corrugations, beads or like described formations has long been understood to provide increased stiffness or load spreading capability in a direction parallel to the bead. However, the use of such a means applied in the composite panel as described above has particular application for access floor panels and provides much greater flexibility in the choice of top sheet gauges or thickness.

It will also be noted that, as shown in FIG. 7, the arrangement of top sheet member 5 and intermediate sheet 3 provide an ideal space immediately under the edge of the top sheet 5 and adjacent to the radius of the down turned flange 17 of the intermediate sheet 3 to catch or

seat a retaining lip on a vinyl edge trim **8** as shown in FIG. 7.

The third or lower sheet **1** is fitted to complete the structure of the panel when it is welded, riveted, bonded, or otherwise attached to the intermediate sheet **3**. The basic structural requirement of the completed panel is to accept a specified load at any location on the load bearing top surface, while allowing minimum deflection. Understructure support for each individual panel can be either full support on all of its edges by a stringer or beam system, or it may simply be a pedestal type of support at each of the panel's four corners. To meet the latter requirement of corner support only, it is necessary for the effective edge of the panel to have the required section properties or section modulus to beam the total specified load to the pedestal supports while allowing minimum deflection when said load is applied at or near any location along a panel edge. It can be noted from the drawings that the lower sheet **1**, when attached to the upper sheet member **5** and intermediate sheet **3**, forms an effective box beam section **9** ideally suited to the task. In the sections taken from FIG. 2 it can be seen that the upper sheet member **5** and lower sheet **1** serve as compression and tension chords, respectively, with the interconnecting flanges **17** providing shear resistant webs for the beams.

In like manner, it can be observed that a given load applied at the center of the panel must be redistributed and reacted at the four corners of the panel, in a system utilizing only pedestals for understructure support. As shown in FIG. 3, the special forming of the lower sheet **1**, when attached to the top sheet member **5** and intermediate sheet **3**, again forms a closed box section beam **9** of high load carrying capacity. It is this basic box beam structure, which in plan view is of cruciform shape, that is the backbone or main strength of the panel. It can be shown by calculation that a centrally applied load will be redistributed equally to the four edges and then in turn to the four corners of the panel.

The cruciform configuration of the box beams of the panel is of major significance when considered in conjunction with the objective of being able to die piece large openings in the panel for cable passage. This is particularly applicable for floor panels in that die cut openings can be made at greatly reduced manufacturing costs and since the main strength member remains relatively undisturbed, there is virtually no loss in strength in other areas. For example, with two openings cut in one half of the panel, the remaining or undisturbed panel half can still carry the full design load with no increase in deflection.

When a given load is applied at other than a central location, the distribution takes place exactly as previously described, except that the reactions will vary in magnitude in direct proportion to their linear relationship with the panel corners when supported by pedestals.

As shown by FIG. 2, the box beams **9** in cruciform shape essentially divide the panel into four equal quadrants. The analogy of beam strength and load distribution as applied to the overall panel can be visualized as of equal application to each of the four quadrants. Each quadrant also is deformed to contain a cruciform shape **21**, the form depth of which may be less than that of the main strength member since the box section beam that it also forms is of considerably reduced length and can therefore have a proportionately reduced section modulus. The smaller cruciform shape **21** of each quadrant blends smoothly into the flat sheet plane at the periphery of the area where all three sheet elements **1**, **3** and **5** are in direct contact and where structural attachment is made by spotwelds **23** or other means of attachment. This point of direct contact is also the location where the panel may later be pierced or die cut for openings as previously described.

An important feature of the lower sheet **1** is that it requires no notching, piercing or other fabricating to enable attachment to the upper sheet. The absence of notches results in a smooth sheet, completely free of stress risers and appreciably increases the fatigue life of the panel while decreasing sensitivity to extreme or impact loading.

An added feature of the lower sheet **1** is that the upturned flanges **13** on all four edges are used to complete the box sections (FIG. 4). While this latter structure is not entirely new, the means of utilizing its shape to press inward and securely hold the edge trim **8** in a compression grip against the top sheet **5** is of great value in holding the edge trim without the use of adhesive or other alternate means. Of further significance is the fact that the edge trim vinyl **8**, when trapped by the shown construction can be flush with the metal at the periphery of the panel which greatly reduces the vulnerability of the edge to handling damage during storage, shipping, and actual installation in a floor system.

The composite construction of this invention as disclosed in FIGS. 1–9, lends itself to fabrication from various ferrous or non-ferrous metals. In addition, this structure is suitable for fabrication from non-metallic substances, such as high impact-resistant plastics. Construction in any material allows the use of sound deadening and/or fire extinguishing coatings, or medium to be applied to the lower surface.

The method of joining the sheet elements in the present invention enables the sheet elements to be in flat and direct contact over ample area to obtain an excellent weld condition completely surrounding the large **9** and small **21** cruciform shaped strength ribs.

As shown in the drawings, the sheet member **5** and sheets **1** and **3** are made of metal, preferably steel, in the interests of strength. It is to be understood, however, that plastics such as those used in hardware can also be used. The metal sheet member and sheets are spot welded to one another at a plurality of spot weld points **23**. Generally, spot welds are placed adjacent the raised ribs **9** and **21** as well as indentations **19** but the precise number and placement of the weld points can vary depending on the degree of stiffness desired in the panel. Alternatively, the sheet member and sheets can be adhered to one another at all surfaces wherever they meet.

The thickness of the sheets and sheet member can vary depending on the intended use of the panel. In a relatively light weight structure the thickness of sheets **1** and **2** and the sheet member **3**, can all be about the same, say 0.03 inch thick. In a heavier panel, the bottom sheet **1** can about equal in thickness the combined thickness of member **5** and sheet **3**, say 0.06 inch. Again, depending on the load to be placed on a floor assembled from the panels, stringers on adjustable pedestals can be used as disclosed in Pat. No. 3,420,012. Stringers placed between the pedestals provide additional support to all four peripheries of the panels and increase the floor system lateral stability. If no stringers are used, the corners only of each panel are supported on the pedestal, with each pedestal supporting a corner from each of four intersecting panels. In any event, it is preferred that an aperture or indentation **25** should be formed at each corner of the panel to secure projections such as projections **24** on the pedestal head disclosed in Pat. No. 3,420,012.

What is claimed is:

1. A modular floor panel comprising a substantially flat top sheet member, a bottom sheet with integrally formed box beam sections at each edge, said bottom sheet having a generally cruciform plan shape of additional box beam sections which intersect at the approximate center of said panel, an intermediate sheet having stiffening beads fitting within and oriented perpendicular to at least some of the box beam sections of said bottom sheet, said intermediate and bottom sheets being substantially parallel and having opposing flanged peripheries which overlap one another when said panel is assembled, the box beam sections of said panel forming a series of closed

and interconnecting panel parts of great strength which are highly resistant to deformation and deflection under load.

2. The panel of claim 1, wherein said additional box beam sections divide said bottom sheet into four similar parts and said parts each contain further box beam sections of cruciform configuration.

3. The panel of claim 2, wherein said box beam sections are deeper than said further box beam sections and stiffening beads fit within said box beam sections and said additional box beam sections.

4. The panel of claim 1, wherein said sheets and sheet member overlie and are connected to one another adjacent said box beam sections.

5. The panel of claim 4, wherein said sheets and sheet members are welded to one another adjacent said box beam sections and along said opposing flanged peripheries.

6. The panel of claim 1, wherein the flanges of said bottom sheet overlie the flanges of said intermediate sheet, said flanges of the bottom sheet being bent outwardly to receive a T-shaped edge trim, said trim being wedged between said top sheet member and said bottom sheet.

7. The panel of claim 6, wherein a tread surface overlies said top sheet member and the head of said T-shaped edge trim is held flush with said tread surface and the outer sides of said panel.

8. The panel of claim 1, said sheets and said sheet member are made of steel and spot welded to one another.

References Cited

UNITED STATES PATENTS

2,294,890	9/1942	Brinker	52—618
3,236,018	2/1966	Graham	52—619
3,279,134	10/1966	Donovan	52—126
3,295,272	1/1967	Kanno	52—126
3,420,012	1/1969	Liskey	52—630X

FOREIGN PATENTS

832,231	1938	France	52—618
313,525	1930	Great Britain	52—618

JOHN E. MURTAGH, Primary Examiner

U.S. Cl. X.R.

52—624, 630